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SUPERCRITICAL FLUID EXTRACTION OF COAL

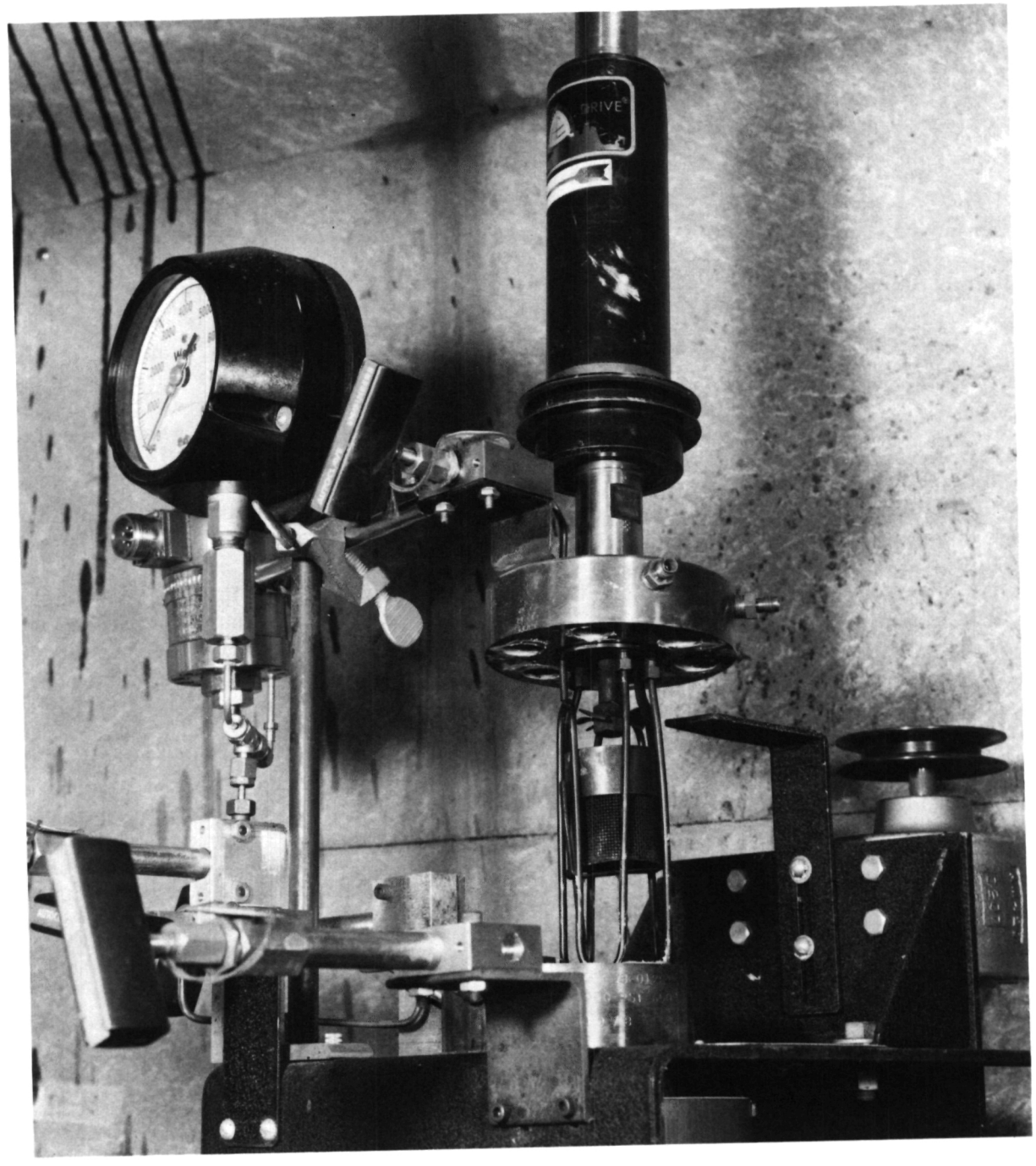
In collaboration with the Caltech Chemical Engineering Department, JPL designed and built a coal batch high-pressure autoclave system for experimentation with supercritical fluid extraction processes. Gases heated above their critical temperatures and compressed to near-liquid densities are called supercritical fluids. These fluids have unusual solvent power capable of breaking down organic matter in coal at a relatively low temperature.

The testing of supercritical fluid extraction processes involved experiments with four types of solvents and three different coals -- two bituminous types and one western lignite. Up to 52 percent by weight of coal (moisture-free) was extracted from one bituminous coal using a unique mixture of two aromatic solvents, phenanthrene and toluene, at 380 degrees Celsius and 61 atmospheres of pressure. The mixture was also effective on the two other coals. The dual-solvent system appears to enhance the extractibility of organic matters. (Pure toluene being used alone in some pilot plants extracts only 20 percent by weight.)

Decreases in weight after extraction agreed well with increases in ash content in the residual char. Sulfur and trace metal contents of the coal extract also should be lower than those of raw coal. Besides phenanthrene, several other dissolution agents may be feasible, including an economical solvent containing anthracene oil.

The process, along with Caltech efforts on mass transfer effects and structural changes, holds promise as a viable alternative for coal liquefaction to meet national energy needs.

Figure (*opposite page*): This 300-cubic-centimeter high-pressure autoclave reactor system equipped with gas chromatography analysis capability was built at JPL for innovative investigation on supercritical fluid extraction of coals. The picture shows a coal basket (center of shaft), which is normally immersed in the supercritical fluid during the test operation, the pressure-sealed magnetic stirrer above it, solvent and product sampling ports, plus pressure monitoring and heating devices.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